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SIX DOLLARS

A CAHNERS PUBLICATION

Electronic Business

FOR MANAGEMENT IN ELECTRONICS, COMPUTER & SYSTEMS COMPANIES — WORLDWIDE

APRIL 30, 1990

RODGERS REACHES UP

For Cypress, growing fast means thinking small

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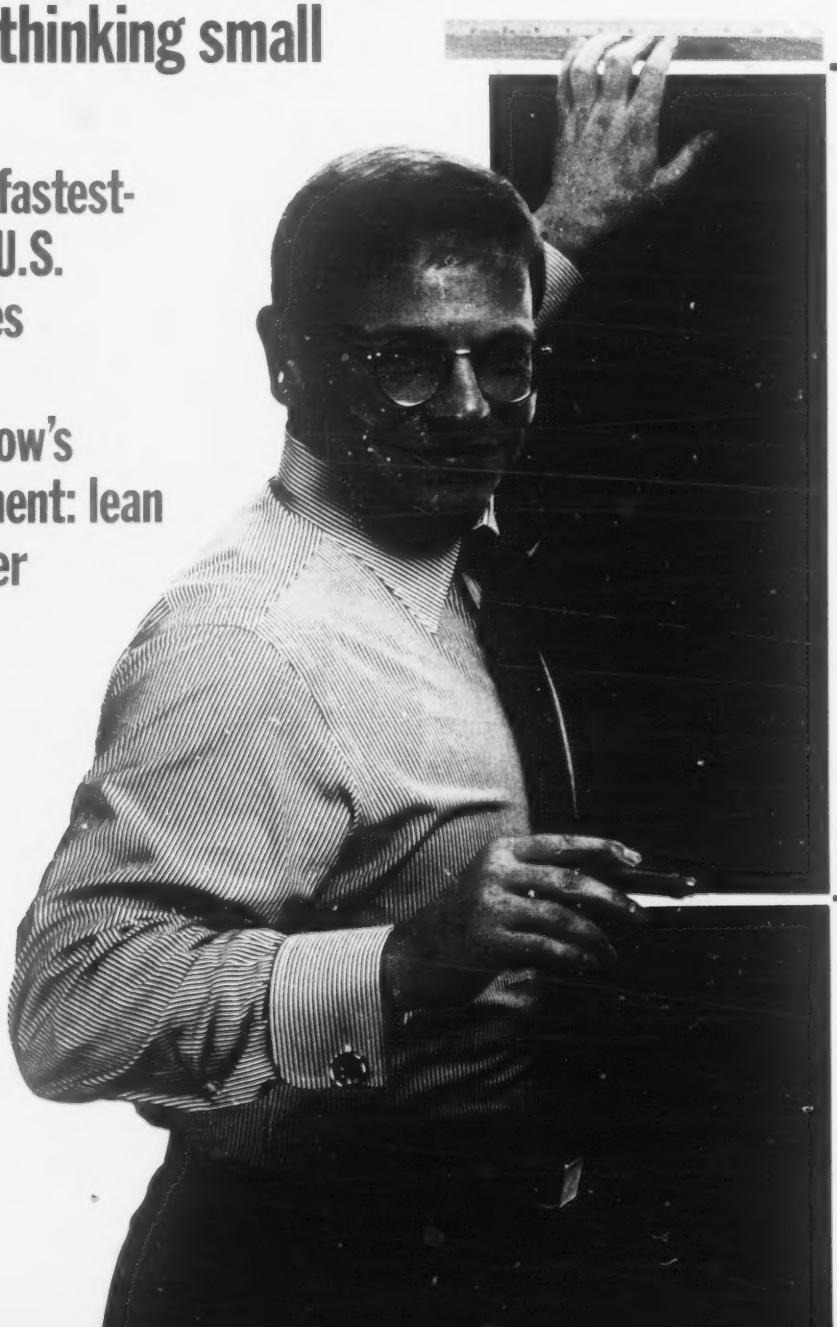

T.J. Rodgers, Cypress Semiconductor's president and CEO

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VOL. 16, NO. 8

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Cover photograph Christopher Springmann

PAGE 34 Cypress' T.J. Rodgers: How big can he grow?

COVER STORY/STRATEGIES

34 For Cypress, growing fast means thinking small

Call him what you want: brash, outspoken, tyrannical. But T.J. Rodgers has Cypress on the fast track. Rodgers has guided his San Jose company to the top of this year's exclusive ELECTRONIC BUSINESS ranking of the 100 fastest-growing U.S. electronics companies. How did he do it? Obsessive attention to detail and an entrepreneurial drive that keeps the company humming.

UPDATE

15 Business Trends
Electronics executives lobby Washington; Motorola's systems come out of the closet; DAT may finally escape U.S. "gray market"; Italy hooks TI, but angers native son; Motorola-Hitachi decision jolts industry; distributors push for share of workers; new consortium to share quality message; Lotus, Novell must meld cultures; will Congress tighten software copyrights?; North American Philips puts an American at the helm.

25 Economic Trends
High technology needs a competitiveness summit; export control reform stirring to life; Japan's R&D push gets government support.

29 Companies to watch
C-Cube Microsystems' image-compression processor chip; Da Vinci Graphics' penless plotters; LANs without wires from Untied Telecom.

31 Commentary
An Wang, the founder of Wang Laboratories who died last month of cancer, left his mark on the world in many different ways — as a scientist, philanthropist and entrepreneur. He will be missed.

STRATEGIES

34 For Cypress, growing fast means thinking small
The number that lands Cypress at the top of this year's ELECTRONIC BUSINESS ranking of the 100 fastest-growing U.S. electronics companies is indeed impressive: average annual compounded growth over the last six years of 128%. At nearly $200 million in revenue last year, Cypress is a model for the new breed of lean and hungry Silicon Valley semiconductor companies.

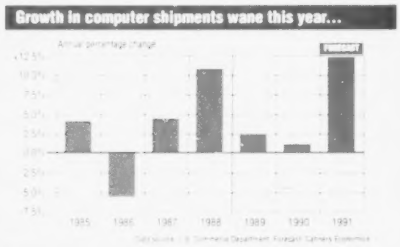
44 Top 100 fastest-growing U.S. companies

MANAGING RESOURCES

54 Electronics to Bush: Do more to lower cost of capital
President Bush's plan to lower the cost of capital by reducing the tax rate on capital gains is fine as far as it goes, but it doesn't go far enough, say many electronics industry executives. The industry wants other government moves to level global playing fields.

58 Lean and limber will describe the company of the future
Today's corporations have evolved into organizations in which top-level executives are insulated from their operational workforces by layers upon layers of middle managers. But a variety of competitive factors this decade will force a shift from that multitiered approach to radically different team-based companies.

PAGE 54 President Bush offers a favorable plan on capital gains taxes, but electronics wants more



PAGE 82 Business Barometer: Computer makers see a glimmer of hope

PAGE 29 C-Cube Microsystems' Alexandre Balkanski: Producing graphics chips that compress complex images

PAGE 75 Stratus' William Elliott: Telecom "has expressed a very clear interest in Unix systems"

PAGE 64 Ericsson's Per Malmborg and Schlumberger's Clermont Matton: It's a deal

PAGE 15 DAT may finally escape the U.S. "gray" market

EUROPE BUSINESS

64 **Schlumberger ATE attacks Europe with a telecom strategy**

A hard-won partnership with Sweden's Ericsson is giving Schlumberger the impetus to pursue the fast-growth niche of telecommunications test. But the protracted courtship has taught some of the world's major ATE vendors a valuable lesson: If partnerships with a lone supplier is a trend, then ATE firms have a tough sell ahead.

ASIA/PACIFIC BUSINESS

67 **TI-Acer DRAM venture: Will this marriage survive?**

Texas Instruments and Acer of Taiwan are putting some big bucks on the table as they confront volatile world memory markets. The happy couple hopes to cash in via a long-term strategy by producing 1- and 4-megabit DRAMs. But this union could prove to be less than blissful.

MARKET PERSPECTIVES

70 **LAN vendors covet lowly telephone networks**

During the mid-1980s, PBX vendors sought to convince LAN users that the same phone wiring that carried voice conversations could also service on-site data communications traffic. But LAN suppliers often belittled the concept — that is until a family of products that ran Ethernet LAN over unshielded twisted-pair phone wiring emerged.

75 **Heavyweights descend on the fault-tolerant Unix market**

With such vendors as Tandem, Stratus and Hewlett-Packard getting into the act, the number of Unix-based computers sold for fault-tolerant applications is rising rapidly. That's bad news for some small specialty vendors who will have to share and share alike their once exclusive domain.

BUSINESS BAROMETER

82 **Computers**

Preliminary numbers show orders are up slightly, but don't expect a full-fledged recovery just yet.

83 **Instruments**

Despite low inventories some sectors, including ATE, will take the brunt of the cyclical slowdown.

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Creating an image

T.J. Rodgers standing beside a bar graph showing his company's rocketing sales growth is a natural. So steady is the ruler in the left hand of the Cypress CEO, poised to draw the next upward sales line. And so self-assured is the smile on the face. These images of Rodgers on the cover of this issue say loads about the man: confident, impressive, always reaching for more.

That's what a cover is supposed to do, says art director Michael Roach: "A simple concept that gets the idea of the story across to readers instantaneously." The basic idea here is to reflect that Cypress, led by hard-charging Rodgers, has been named the fastest-growing U.S. electronics company in our exclusive annual ranking.

All of this comes up as a way to introduce Michael, who worked for other Cahners magazines during his five years with the company before joining ELECTRONIC BUSINESS in November. Executing cover concepts is perhaps an art director's greatest challenge. The process is a protracted one, from discussing story concepts with editors to directing photographers to selecting appropriate shots. After all, the cover is the first thing the reader sees.

Once the cover photograph does its job, the next step is to illustrate the story itself. What better way to illustrate Cypress' fast growth than to have Rodgers, his back turned and down to business, actually charting the company's growth himself. As senior editor Bruce Rayner points out in his story, the tyrannical and brash Rodgers *is* Cypress. Between the cover and inside photographs, a compelling story about Cypress and Rodgers is already being told — before any words are read.

Art director Michael Roach

Our exclusive on the 100 fastest-growing U.S. electronics companies begins a new round of similar special reports to come this year. They include the most profitable companies, top R&D spenders, top European and Japanese companies, and, of course, the ELECTRONIC BUSINESS 200. Our hats must go off to senior editor Linda Stallmann who compiles all of this financial information from company reports and documents and then makes the insightful analysis.

The "Facts behind the figures," part of this year's ranking injects some perspective into the raw numbers. For example, the five-year compounded annual growth rate of the 100 companies on the list decreased over the previous year's record figure. And there are 26 companies new to the list this year. Those are just a couple of tidbits, but there's more . . .

MARVIN GREENE, section editor

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BPA ABP

Facts behind the figures

Who are the 100 fastest-growing electronics companies in the United States? The following pages, compiled by senior financial editor Linda Stallmann, comprise ELECTRONIC BUSINESS' annual special report that ranks and analyzes fast-growth companies. To be included in our ranking, companies must be publicly held; be based in the United States; achieve revenue of $80 million or more; derive 70% of revenue from the electronics or computer industries, and have a six-year operating history with at least $1 million in sales in the base year. The growth rates by which the companies are ranked is compounded annually for five years.

Pacesetters Conner Peripherals Inc., Dell Computer Corp. and Chips and Technology Inc. are excluded from consideration as a result.

Top 10 fastest-growing companies

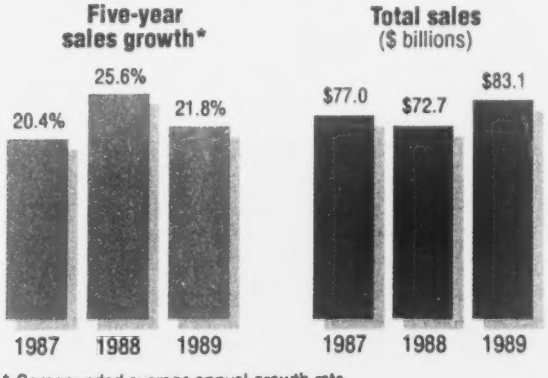
1989 rank	Company	Market	Five-year sales growth	Fiscal 1989 sales ($ millions)
1	**Cypress**	Semiconductors	127.8%	$199.3
2	**Silicon Graphics**	Workstations	117.9%	263.8
3	**Oracle Systems**	Database software	115.0%	583.7
4	**Sun Microsystems**	Workstations	114.5%	1,765.4
5	**Cadence**	IC design software	89.8%	142.8
6	**Novell**	LAN software	89.1%	421.9
7	**Maxtor**	Disk drives	84.4%	351.0
8	**3Com**	LAN equipment	81.0%	385.9
9	**Informix Software**	Software systems	72.1%	145.0
10	**Integrated Device**	Semiconductors	66.4%	180.7

Slower growth, higher sales

In 1989 the 100 fastest-growing U.S. electronics companies had a five-year compounded annual growth rate of 21.8% from fiscal 1984 to 1989. This is a decrease over 1988's record of 25.6%. Given the slowdown in the electronics industry in general and the computer industry in particular, these results are not surprising. Even though the rate of growth decelerated, total sales climbed to $83.1 billion last year from $72.7 billion in 1988.

The big picture

Figures for the 100 fastest-growing companies



* Compounded average annual growth rate

The top newcomers

Company	Five-year sales growth	Fiscal 1989 sales ($ millions)	1989 rank
Cypress	127.8%	$199.3	1
Cadence	89.8%	142.8	5
Maxtor	84.4%	351.0	7
Informix Software	72.1%	145.0	9
Integrated Device	66.4%	180.7	10
Tandon	57.6%	377.9	11
Pyramid Technology	53.5%	103.9	14
Flextronics	49.4%	201.9	18
EMC	47.7%	132.3	21
Silicon Valley Group	33.9%	131.1	32

Newcomers and old friends

There are 29 companies joining the 1989 list, compared with 26 joining in 1988. Most of these current newcomers are making their first appearance in the ranking; five have reappeared after several years absence.

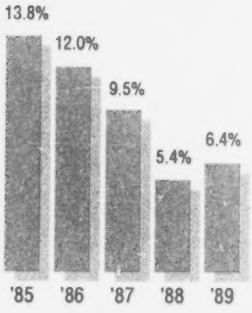
Most notable among the repeaters is Tandon Corp., making its first appearance since 1986. The desktop computer maker's strong presence in the booming European market, helped the company climb to the 11th spot on the new listing. Others reappearing include DSC Communications Corp. (91), Dynascan Corp. (62), E-Systems Inc. (79) and MTS Systems Corp. (81).

Where's IBM?

The last time IBM was a member of the fastest-growing club was in 1986 with 12% average annual growth. Although its compounded annual growth rate has continued to decline over the past four years, 1989 saw a slight increase to 6.4%.

Turning the corner?

IBM's five-year sales growth



The billion-dollar club

Company	Fiscal 1989 sales ($ millions)	Five-year sales growth	1989 rank
Digital Equipment	$12,742.0	17.9%	66
Hewlett-Packard	11,899.0	14.5%	86
Unisys	10,096.9	16.0%	78
Apple Computer	5,284.0	28.4%	44
Intel	3,126.8	13.9%	89
Compaq Computer	2,876.1	54.3%	12
Amdahl	2,101.1	21.9%	60
Sun Microsystems	1,765.4	114.5%	4
Tandem Computers	1,632.5	25.1%	49
E-Systems	1,626.4	15.8%	79
Seagate Technology	1,371.6	31.9%	35
General Instrument	1,304.7	13.9%	90
Loral	1,187.0	23.2%	55
Computer Associates	1,030.2	45.4%	23

Have billions, but keep on growing

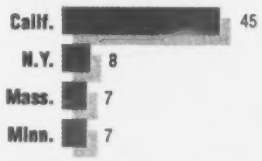
There are 14 billion-dollar-plus companies on this year's list up one more than from last year. These big, established companies have an average five-year compounded annual growth rate of 19.7%; total sales amount to $58 billion or 70% of the $83.1 billion for all of the top 100.

California: a place to grow

California extends its hold over the previous year's lead as the state with the most revenue gainers. Last year, 45 of the fastest U.S. electronics companies called California home — four more than in 1988. The biggest loser was Massachusetts tumbling to only seven companies, down from 11 in 1988 and 14 in 1987. New York was unchanged at eight.

Hot growth spots

California claims the most fast-growth companies



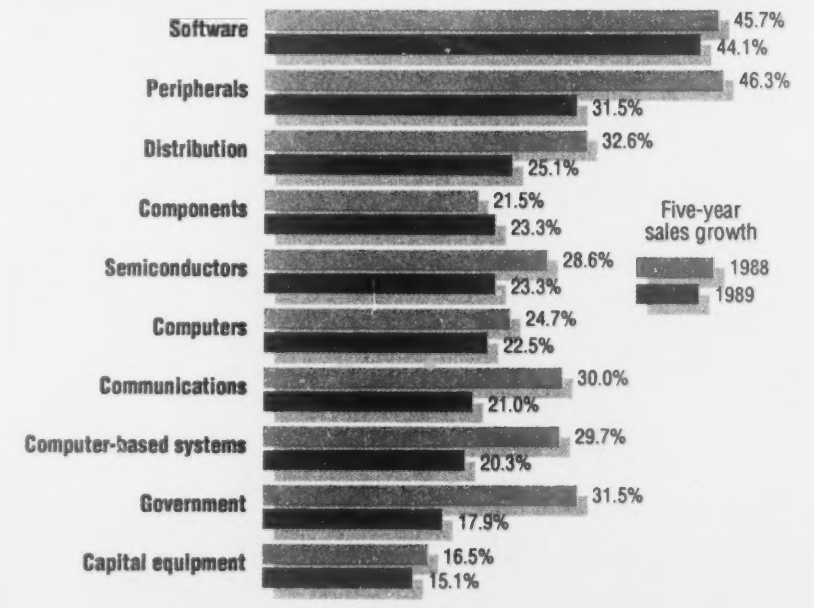
Software makers regain lead for speedy growth

Makers of computer software products scored the highest collective average growth rate — 44.1%, followed by the previous year's top-ranked sector, computer peripherals products, with 31.5% compounded annual growth.

But the software sector's growth rate has slowed from 64.3% in 1987 and 45.7% in 1988, probably an indication of a maturing industry. Three of the top 10 are fairly young software companies, such as Oracle Systems Corp., Cadence Design Systems Inc. and Informix Inc. The more mature companies in an otherwise adolescent industry include Ashton-Tate, Lotus Development Corp., Computer Associates International Inc. and Microsoft Corp.

In comparing the weighted averages for five-year compounded growth in 1989 versus 1988 all but one industry is affected by the general sluggishness in the industry. □

The fastest-growing segments



Fastest-growing companies

1989 rank	Company	Five-year sales growth (compounded average annual rate)	Fiscal 1989 sales ($ millions)	Fiscal 1989 profits ($ millions)	Fiscal year ended	Location
1	Cypress Semiconductor	127.8%	$199.3	$30.7	12/89	San Jose, Calif.
2	Silicon Graphics	117.9%	263.8	11.5	6/89	Mountain View, Calif.
3	Oracle Systems	115.0%	583.7	81.8	5/89	Belmont, Calif.
4	Sun Microsystems	114.5%	1,765.4	60.8	6/89	Mountain View, Calif.
5	Cadence Design Systems	89.8%	142.8	27.8	12/89	Santa Clara, Calif.
6	Novell	89.1%	421.9	48.5	10/89	Provo, Utah
7	Maxtor	84.4%	351.0	5.2	3/89	San Jose, Calif.
8	3Com	81.0%	385.9	34.3	5/89	Santa Clara, Calif.
9	Informix	72.1%	145.0	6.4	12/89	Menlo Park, Calif.
10	Integrated Device Technology	66.4%	180.7	17.9	3/89	Santa Clara, Calif.
11	Tandon	57.6%	377.9	-4.3	12/89	Moorpark, Calif.
12	Compaq Computer	54.3%	2,876.1	333.3	12/89	Houston, Texas
13	Vishay Intertechnology	53.7%	415.6	17.8	12/88	Malvern, Pa.
14	Pyramid Technology	53.5%	103.9	8.4	9/89	Mountain View, Calif.
15	Western Digital	53.0%	992.1	34.3	6/89	Irvine, Calif.
16	Microsoft	52.5%	803.5	170.5	6/89	Redmond, Wash.
17	Stratus Computer	51.9%	341.3	35.4	12/89	Marlborough, Mass.
18	Flextronics	49.4%	201.9	-11.3	3/89	Fremont, Calif.
19	Rexon	48.5%	146.8	10.2	9/89	Culver City, Calif.
20	AST Research	48.2%	456.5	-7.5	6/89	Irvine, Calif.
21	EMC	47.7%	132.3	-18.6	12/89	Hopkinton, Mass.
22	Wyse Technology	47.6%	452.3	-21.2	3/89	San Jose, Calif.
23	Computer Associates International	45.4%	1,030.2	163.5	3/89	Garden City, N.Y.
24	LSI Logic	45.3%	546.9	-24.9	12/89	Milpitas, Calif.
25	Ashton-Tate	43.9%	265.3	-28.6	12/89	Torrance, Calif.
26	QMS	38.6%	215.8	8.2	9/89	Mobile, Ala.
27	Micron Technology	38.6%	446.4	106.1	8/89	Boise, Idaho
28	Micropolis	38.6%	307.3	-49.8	12/89	Chatsworth, Calif.
29	Archive	36.6%	181.4	15.3	9/89	Costa Mesa, Calif.
30	Intermec	34.6%	131.1	8.0	3/89	Lynnwood, Wa.
31	Mentor Graphics	34.0%	380.0	44.8	12/89	Beaverton, Oregon
32	Silicon Valley Group	33.9%	131.1	9.6	9/89	San Jose, Calif.
33	Emerson Radio	33.2%	761.6	9.6	3/89	North Bergen, N.J.
34	VLSI Technology	32.9%	288.5	0.5	12/89	San Jose, Calif.
35	Seagate Technology	31.9%	1,371.6	0.3	6/89	Scotts Valley, Calif.
36	KLA Instruments	31.0%	165.5	11.7	6/89	Santa Clara, Calif.
37	Teixon	30.9%	159.6	14.9	3/89	Akron, Ohio
38	Symbol Technologies	30.5%	222.3	19.0	12/89	Bohemia, N.Y.
39	Stanford Telecommunications	29.9%	85.7	2.8	3/89	Santa Clara, Calif.
40	Richardson Electronics	29.9%	156.6	11.9	5/89	LaFox, Ill.
41	BancTec	29.3%	123.5	7.7	3/89	Dallas, Texas
42	Digital Communications Assoc.	28.8%	208.2	17.7	6/89	Alpharetta, Ga.
43	Lotus Development	28.8%	556.0	68.0	12/89	Cambridge, Mass.
44	Apple Computer	28.4%	5,284.0	454.0	9/89	Cupertino, Calif.
45	Cray Research	28.0%	784.7	89.0	12/89	Minneapolis, Minn.
46	Microsemi	27.9%	103.5	-8.9	9/89	Santa Ana, Calif.
47	Anthem Electronics	27.4%	319.0	15.8	12/89	San Jose, Calif.
48	Quantum	25.4%	208.0	12.9	3/89	Milpitas, Calif.
49	Tandem Computers	25.1%	1,632.5	118.3	9/89	Cupertino, Calif.
50	Inmac	25.0%	249.5	-6.4	7/89	Santa Clara, Calif.

(Continued)

Fastest-growing companies

1989 rank	Company	Five-year sales growth (compounded average annual rate)	Fiscal 1989 sales ($ millions)	Fiscal 1989 profits ($ millions)	Fiscal year ended	Location
51	Data Switch	24.9%	$106.4	-$1.1	12/89	Shelton, Conn.
52	Applied Materials	24.4%	501.8	51.5	10/89	Santa Clara, Calif.
53	Hutchinson Technology	24.1%	92.3	-5.7	9/89	Hutchinson, Minn.
54	ASK Computer Systems	23.4%	186.3	13.5	6/89	Mountain View, Calif.
55	Loral	23.2%	1,187.0	60.3	3/89	New York, N.Y.
56	Ultimate	23.1%	199.9	-13.0	4/89	East Hanover, N.J.
57	Computer Task Group	23.0%	233.0	-7.8	12/89	Buffalo, N.Y.
58	Western Micro Technology	22.5%	102.0	3.4	3/89	Saratoga, Calif.
59	Bolt Beranek and Newman	22.3%	291.6	-31.5	6/89	Cambridge, Mass.
60	Amdahl	21.9%	2,101.1	153.0	12/89	Sunnyvale, Calif.
61	Valid Logic Systems	21.2%	173.9	10.0	12/89	San Jose, Calif.
62	Dynascan	19.9%	247.7	4.2	12/89	Chicago, Ill.
63	Xicor	18.2%	90.2	0.4	12/89	Milpitas, Calif.
64	Dynatech	18.2%	399.5	18.6	3/89	Burlington, Mass.
65	Westmark International	18.1%	438.8	19.1	12/89	Seattle, Wash.
66	Digital Equipment	17.9%	12,742.0	1,073.0	6/89	Maynard, Mass.
67	Molex	17.8%	571.9	57.7	6/89	Lisle, Ill.
68	SCI Systems	17.7%	986.8	20.9	6/89	Huntsville, Ala.
69	ADC Telecommunications	17.5%	196.4	16.4	10/89	Minneapolis, Minn.
70	Daisy Systems	17.3%	153.7	-140.1	9/89	Mountain View, Calif.
71	Audiovox	16.8%	293.4	-1.6	11/88	Hauppauge, N.Y.
72	Marshall Industries	16.8%	533.5	21.4	5/89	El Monte, Calif.
73	Miltope Group	16.8%	94.4	-2.3	1/90	Melville, N.Y.
74	Applied Magnetics	16.6%	314.1	1.2	9/89	Goleta, Calif.
75	AEL Industries	16.4%	137.0	-2.0	2/89	Lansdale, Pa.
76	Iomega	16.3%	109.0	11.2	12/89	Roy, Utah
77	Intergraph	16.3%	860.1	79.5	12/89	Huntsville, Ala.
78	Unisys	16.0%	10,096.9	-639.3	12/89	Detroit, Mich.
79	E-Systems	15.8%	1,626.4	83.0	12/89	Dallas, Texas
80	Cherry	15.6%	213.6	4.4	2/89	Waukegan, Ill.
81	MTS Systems	15.3%	152.6	11.1	9/89	Eden Prairie, Minn.
82	Network Systems	15.3%	144.8	17.3	12/89	Minneapolis, Minn.
83	Sheldahl	15.0%	86.6	-1.7	7/89	Northfield, Minn.
84	Park Electrochemical	15.0%	146.9	7.6	2/89	Lake Success, N.Y.
85	Evans & Sutherland Computer	14.6%	138.6	-0.1	12/89	Salt Lake City, Utah
86	Hewlett-Packard	14.5%	11,899.0	829.0	10/89	Palo Alto, Calif.
87	Keithley Instruments	14.3%	88.7	4.1	9/89	Cleveland, Ohio
88	Medtronic	14.0%	741.7	97.4	4/89	Minneapolis, Minn.
89	Intel	13.9%	3,126.8	391.0	12/89	Santa Clara, Calif.
90	General Instrument	13.9%	1,304.7	85.5	2/89	New York, N.Y.
91	DSC Communications	13.9%	429.7	34.2	12/89	Plano, Texas
92	Pacific Scientific	13.8%	169.6	3.4	12/89	Newport Beach, Calif.
93	Burr-Brown	13.8%	169.5	8.7	12/89	Tucson, Ariz.
94	Tellabs	13.7%	181.3	7.1	12/89	Lisle, Ill
95	Genicom	13.5%	256.9	-24.3	12/89	Waynesboro, Va.
96	Emulex	13.1%	148.7	13.3	6/89	Costa Mesa, Calif.
97	Dynamics Research	13.1%	88.5	3.6	12/89	Wilmington, Mass.
98	Methode Electronics	13.0%	122.2	2.2	4/89	Chicago, Ill.
99	Recognition Equipment	12.8%	255.9	-38.8	10/89	Dallas, Texas
100	Finnigan	12.8%	118.8	-3.9	12/89	San Jose, Calif.

Source: ELECTRONIC BUSINESS

Fastest-growing companies by industry segment

Five-year compounded average annual growth rate

Capital equipment

	Five-year growth Sales	Profits	1989 rank
Silicon Valley Group	33.9%	12.0%	32
KLA Instruments	31.0%	15.6%	36
Applied Materials	24.4%	30.7%	52
MTS Systems	15.3%	23.4%	81
Hewlett-Packard	14.5%	4.5%	86
Keithley Instruments	14.3%	-0.4%	87
Weighted average	**15.1%**	**5.6%**	

Communications

	Five-year growth Sales	Profits	1989 rank
Novell	89.1%	164.5%	6
3Com	81.0%	113.9%	8
Stanford Telecommunications	29.9%	15.7%	39
Digital Communications Associates	28.8%	27.8%	42
Inmac	25.0%	NM	50
Data Switch	24.9%	NM	51
Bolt Beranek and Newman	22.3%	NM	59
Dynascan	19.9%	NM	62
Dynatech	18.2%	9.6%	64
ADC Telecommunications	17.5%	38.3%	69
Audiovox	16.8%	NM	71
Network Systems	15.3%	2.1%	82
General Instrument	13.9%	12.8%	90
DSC Communications	13.9%	7.7%	91
Tellabs	13.7%	-11.2%	94
Weighted average	**21.0%**	**19.6%**	

Computers

	Five-year growth Sales	Profits	1989 rank
Silicon Graphics	117.9%	NM	2
Sun Microsystems	114.5%	87.0%	4
Tandon	57.6%	NM	11
Compaq Computer	54.3%	91.7%	12
Pyramid Technology	53.5%	NM	14
Stratus Computer	51.9%	45.6%	17
Rexon	48.5%	NM	19
Apple Computer	28.4%	47.9%	44
Cray Research	28.0%	14.4%	45
Tandem Computers	25.1%	22.5%	49
Amdahl	21.9%	33.2%	60
Digital Equipment	17.9%	26.7%	66
Unisys	16.0%	NM	78
Weighted average	**22.5%**	**17.4%**	

Computer-based systems

	Five-year growth Sales	Profits	1989 rank
Mentor Graphics	34.0%	40.0%	31
Telxon	30.9%	38.3%	37
Symbol Technologies	30.5%	29.8%	38
BancTec	29.3%	NM	41
ASK Computer Systems	23.4%	17.0%	54
Valid Logic Systems	21.2%	NM	61
Daisy Systems	17.3%	NM	70
Intergraph	16.3%	4.8%	77
Evans & Sutherland	14.6%	NM	85
Recognition Equipment	12.8%	NM	99
Finnigan	12.8%	NM	100
Weighted average	**20.3%**	**-43.0%**	

Government

	Five-year growth Sales	Profits	1989 rank
Loral	23.2%	12.2%	55
SCI Systems	17.7%	12.6%	68
Miltope Group	16.8%	NM	73
AEL Industries	16.4%	NM	75
E-Systems	15.8%	6.0%	79
Pacific Scientific	13.8%	-13.6%	92
Dynamics Research	13.1%	12.6%	97
Weighted average	**17.9%**	**6.0%**	

Distribution

	Five-year growth Sales	Profits	1989 rank
Emerson Radio	33.2%	-2.6%	33
Anthem Electronics	27.4%	23.6%	47
Western Micro Technology	22.5%	17.3%	58
Marshall Industries	16.8%	15.4%	72
Weighted average	**25.1%**	**12.0%**	

Components (other than semiconductors)

	Five-year growth Sales	Profits	1989 rank
Vishay Intertechnology	53.7%	23.8%	13
Microsemi	27.9%	NM	46
Molex	17.8%	8.6%	67
Cherry	15.6%	-3.0%	80
Methode Electronics	13.0%	-7.3%	98
Weighted average	**23.3%**	**5.7%**	

Peripherals

	Five-year growth Sales	Profits	1989 rank
Maxtor	84.4%	NM	7
AST Research	48.2%	NM	20
EMC	47.7%	NM	21
Wyse Technology	47.6%	NM	22
QMS	38.6%	9.9%	26
Micropolis	38.6%	NM	28
Archive	36.6%	57.6%	29
Intermec	34.6%	23.4%	30
Seagate Technology	31.9%	-61.1%	35
Quantum	25.4%	3.8%	48
Applied Magnetics	16.6%	-20.1%	74
Iomega	16.3%	34.7%	76
Sheldahl	15.0%	NM	83
Genicom	13.5%	NM	95
Emulex	13.1%	2.4%	96
Weighted average	**31.5%**	**NM**	

Semiconductors

	Five-year growth Sales	Profits	1989 rank
Cypress	127.8%	NM	1
Integrated Device Technology	66.4%	NM	10
Western Digital	53.0%	49.9%	15
LSI Logic	45.3%	NM	24
Micron Technology	38.6%	29.6%	27
VLSI Technology	32.9%	-40.1%	34
Richardson Electronics	29.9%	24.2%	40
Xicor	18.2%	-36.0%	63
Intel	13.9%	14.6%	89
Burr-Brown	13.8%	12.4%	93
Weighted average	**23.3%**	**17.6%**	

Software

	Five-year growth Sales	Profits	1989 rank
Oracle Systems	115.0%	125.9%	3
Cadence	89.8%	NM	5
Informix	72.1%	NM	9
Microsoft	52.5%	60.8%	16
Computer Associates International	45.4%	70.6%	23
Ashton-Tate	43.9%	NM	25
Lotus Development	28.8%	13.5%	43
Ultimate	23.1%	NM	56
Computer Task Group	23.0%	NM	57
Weighted average	**44.1%**	**42.9%**	

NM = Not meaningful, company had a loss in one of the base years

Source: ELECTRONIC BUSINESS

LAN vendors covet lowly telephone networks

As standards emerge quickly, LAN manufacturers are rushing to meet the overwhelming demand for networking over phone wiring

BY DWIGHT B. DAVIS

During the mid-1980s, private branch exchange (PBX) vendors mounted a campaign to convince LAN users that the same telephone wiring that carried voice conversations could also serve as the medium to carry on-site data communications traffic. Local-area networking (LAN) suppliers often belittled the concept, claiming coaxial cable was required to support the high data rates required by interconnected computers, disk servers and printers.

But in August 1987, SynOptics Communications Inc. of Mountain View, Calif., proved the validity of the PBX vendors' claims by introducing a family of products that ran the 10-megabit-per-second (Mbps) Ethernet LAN over unshielded twisted-pair phone wiring. Since then, SynOptics and a host of other LAN vendors have sold hundreds of thousands of unshielded twisted-pair Ethernet nodes, often making use of the very telephone wiring users installed at the behest of the PBX suppliers.

The overwhelming demand for twisted-pair Ethernet LANs has changed the complexion of the entire LAN marketplace. By 1993, phone wiring will constitute almost 50% of all Ethernet media shipments, estimates International Data Corp. of Framingham, Mass. And an emerging industry standard for Ethernet over unshielded twisted pair, called 10Base-T, has given Ethernet a boost that virtually ensures its continued status as the most popular LAN methodology, most analysts agree.

Ethernet, developed by Xerox Corp.'s Palo Alto Research Center in 1973, has become a de facto LAN standard. Just under one million Ethernet nodes were shipped in the United States during 1989, according to market research and consulting firm Forrester Research Inc. of Cambridge, Mass.

Building to 10Base-T

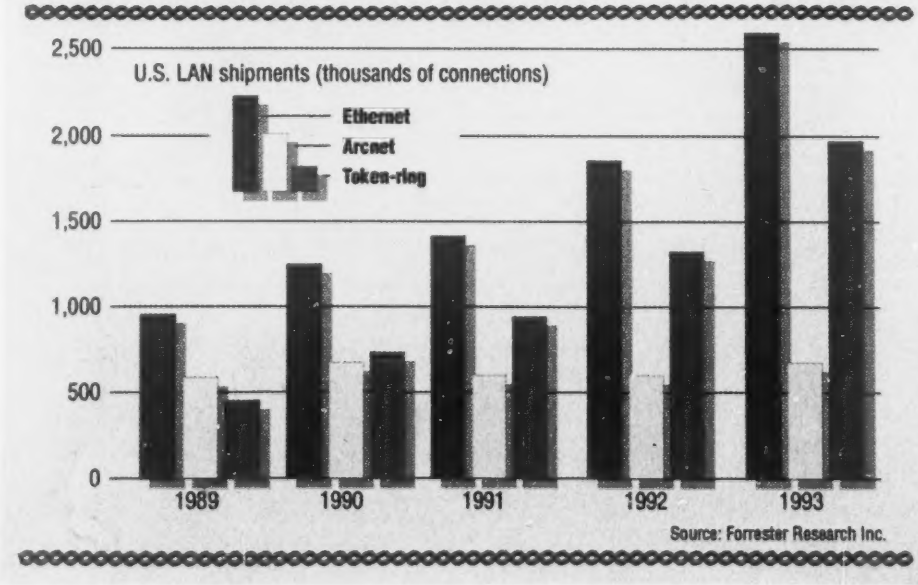
Ethernet's dominance has been threatened in recent years by the IBM-backed token-ring standard, which comes in 4-Mbps and 16-Mbps varieties. In 1989, almost 500,000 token-ring nodes were shipped in the United States, Forrester Research estimates.

Like Ethernet, the lower-speed token-ring LAN now is widely available in unshielded twisted-pair implementations, and a few vendors are beginning to offer 16-Mbps token ring over that medium as well. But a 10Base-T-equivalent standard for token ring is only in the formative stages, and its absence is likely to give phone-wire Ethernet a significant marketing advantage.

"Analysts who earlier predicted that token ring would overtake Ethernet simply didn't factor in the use of unshielded twisted pair for Ethernet," states Michael M. Clair, vice president of marketing and sales at SynOptics.

A wide variety of companies are already moving to claim a share of the 10Base-T Ethernet pie, despite the fact that the standard isn't quite a standard yet. If the Institute of Electrical and Electronics Engineers (IEEE) holds to its ratification sched-

Ethernet: Leader of the local area network pack

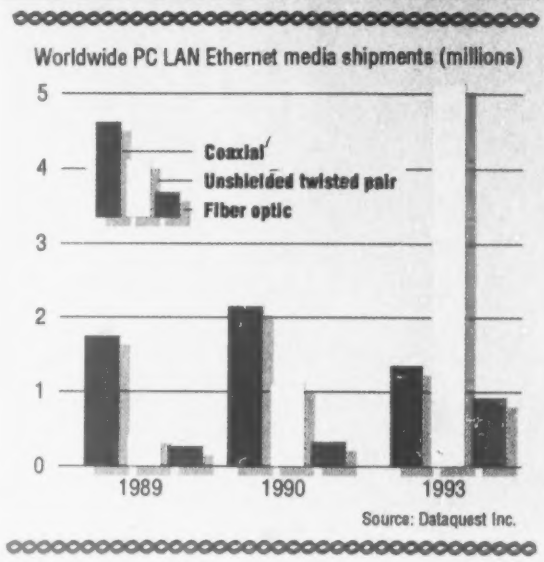


ule, 10Base-T will gain final approval sometime in September.

By early this year, however, Draft 10 of 10Base-T had been accepted by the IEEE 802.3 (Ethernet) work group, and few technical changes are expected in the remaining balloting process. "I'd be comfortable making the decision to come out with commercial products at this point," says Patricia Thaler, chairwoman of the 10Base-T task force within 802.3 and a principal engineer at Hewlett-Packard Co. Because most vendors agree with this assessment, the 10Base-T race is well under way.

At the node level, where devices connect to the network medium, the changes required by 10Base-T are minimal. A standard Ethernet card designed to connect to a coaxial cable is identical to one that connects to twisted pair, aside from a change in the transceiver that sits between the Ethernet controller and the media. This transceiver can be an on-board integrated device or an external box that connects existing coaxial boards to unshielded twisted pair.

Twisted pair: The cable of choice



Transceiver chips

A number of semiconductor vendors are producing 10Base-T chips for on-board designs. Among the companies offering or developing such ICs are NCR Corp., Intel Corp., National Semiconductor Corp., Advanced Micro Devices Inc., Micro Linear Corp. and AT&T. The components are fairly inexpensive; NCR's 92C02 chip, for example, will cost $15 in 5,000-unit quantities.

The transceiver chips alone do require some supporting electronics to implement the full 10Base-T standard, and at least one semiconductor vendor, Intel, is offering a "supercomponent" package to provide the full 10Base-T specification. The two-by-two-inch 82521TB costs $56.50 in 1,000-unit quantities. (Intel also offers an external transceiver, the 82523TB, which costs $72.50 each.)

One step up from the IC components are the 10Base-T adapter boards themselves. A large number of 10Base-T suppliers are active in this market sector, with existing Ethernet board suppliers such as 3Com Corp., Western Digital Corp., Racal InterLan, Intel, and Tiara Computer Systems Inc. leading the charge.

The 10Base-T adapter cards are equivalent in price to their coaxial counterparts, with 8-bit versions priced in the $350 to $450 range, and 16-bit versions costing from $380 to $550. There is also a market for special-purpose cards with features beyond a basic connection. TRW Inc.'s Information Networks Division of Torrance, Calif., for instance, offers a $750 card that provides 256K bytes of memory and on-board support for the TCP/IP networking protocol.

The proliferation of 10Base-T "will cause the cost of Ethernet connections to fall dramatically," predicts Mary Modahl, director of network strategy services at Forrester Research. Currently, the 2.5-Mbps, token-bus Arcnet LAN developed by Datapoint Corp. is the price leader, with connect costs averaging about $150 per node. By 1993, Forrester estimates, Ethernet connect costs will drop to about $180, and Modahl expects the higher-speed Ethernet to replace Arcnet as the "low-cost ubiquitous network."

Andrei Glasberg, president and CEO of Tiara Computer Systems in Mountain View, Calif., agrees. Although the company is known primarily as an Arcnet supplier, revenue from its Ethernet products has already surpassed Arcnet revenue, he says. And Jay Stewart, Tiara senior vice president, predicts Ethernet adapter prices will approach those of Arcnet cards by 1992. "By that point there will be little reason to go with Arcnet other than pure habit," he says.

Star design adds component

Beyond the adapter-card level, twisted-pair Ethernet parts ways with its coaxial-based cousins. The traditional Ethernet implementation is a peer-to-peer bus arrangement, with no central point of control. 10Base-T, inheriting the phone-wire layout of the PBX world, is a physical star, with wires radiating from a central hub wiring closet.

The star topology demands a new type of networking component: a hub concentrator that accepts transmissions from individual stations and broadcasts them to the nodes residing at the end of each of the star's spokes. Full-blown 10Base-T networking suppliers offer concentrators as well as network adapter cards.

Leading the full-service 10Base-T networking pack is SynOptics, whose LattisNet family of products has dominated the pre-standard Ethernet over unshielded twisted-pair marketplace. Vendors offering proprietary solutions in this market had installed about 500,000 nodes by early this year, estimates Clair at SynOptics. "We've shipped about 350,000 of those nodes and therefore hold about a 70% share of the market," he says. The remainder is held by a group of vendors that includes Tandem Computers Inc.'s Ungermann-Bass Inc. subsidiary, Cabletron Systems Inc., David Systems Inc., Gateway Communications Inc., NetWorth Inc., BICC Data Networks Inc., and Nevada Western Inc.

Clair describes the migration from the company's proprietary twisted-pair implementation to 10Base-T as "free and painless," noting that a single SynOptics concentrator can support modules of both types, as well as token-ring connections. "As a result," believes analyst Modahl, "Syn-

Optics has the momentum to maintain its marketplace leadership."

Still, there is no shortage of pretenders to SynOptics' throne. Among the best positioned competitors are current competitors Ungermann-Bass and Cabletron Systems, with 3Com, Digital Equipment Corp., Hewlett-Packard and AT&T also likely contestants.

Lifetime cost benefits

Most of the 10Base-T vendors promote the Ethernet standard as a means by which companies can reduce or avoid the expense of pulling LAN cabling throughout their buildings. Because many buildings already contain unused twisted-pair wiring in the required star topology, 10Base-T customers can often dispense with labor-intensive wiring costs altogether, the vendors say.

The pervasiveness of appropriate wiring, as well as vendors' willingness to use it where it exists, is not clear, however. The 10Base-T standard specifies a certain grade of unshielded twisted-pair cabling, and testing and qualifying an existing cable plant to ensure the right wire is present "is not an easy thing to do," according to Paul Nikolich, a consulting member of the technical staff at Racal InterLan of Boxborough, Mass.

Still, Nikolich says, even if new wire must be pulled, twisted-pair cabling is less expensive than coaxial cable, as well as more flexible. And since the wiring must be placed in a star topology that mirrors the existing phone-wiring system, it is likely that it can share existing phone-wire conduits, he points out.

On a more esoteric level, "Unshielded twisted pair has a lot of appeal simply because it is not as threatening a technology to users as is coax," says Joseph Aro, manager of marketing for TRW's Information Networks Division. As a result, "It's a lot easier sell," he says.

Even with the cost advantages inherent in the 10Base-T wiring scheme, the fact that the standard requires central hub concentrators can boost the capital costs above that of a coaxial installation, which requires no concentrators.

One way to reduce this cost may be to have a file server double as the 10Base-T hub, believes Sam Brown, president of LAN start-up Kodiak Technology, a Seeq Technology Inc. subsidiary in San Jose. Kodiak already offers several coaxial Ethernet products and will introduce a 10Base-T line in the May-June timeframe. A future Kodiak product will, in fact, be a file server hub, "which will be the most cost effective approach for smaller networks," Brown says.

Comparing leading LANs

	Speed	Average connection cost/node	Topology
Ethernet	10 Mbps	$350-$550	Bus/star
Token ring	4 & 16 Mbps	$600-$800	Star
Arcnet	2.5 Mbps	$150-$250	Bus/star

Token ring is perceived as more expensive than Ethernet because of adapter costs that today average about $760

Reduced network costs

Despite the added concentrator cost, 10Base-T proponents argue that the twisted-pair networks will save users money in the long term. "The big advantage of 10Base-T is reduced maintenance and reconfiguration costs over the life of the network," says Tim Dunn, product manager for twisted-pair products at Intel.

Dunn and others point out that adding or moving networked stations on a star topology is much simpler than performing the same activities on a coaxial, bus-based Ethernet. Even more important, most agree, is the fact that the hub in a 10Base-T network can serve as a natural point to implement network monitoring and management.

The 10Base-T standard itself has a built-in "link test" function that verifies the physical connection of each spoke on the star. On top of that, most of the concentrator vendors are adding sophisticated network management software to monitor the physical network closely.

SynOptics, for one, believes its network management capabilities "represent the true value added" to the generic 10Base-T products, according to Clair. Still, not all 10Base-T vendors are following this high-end approach to the market.

"We offer some network management and diagnostics, but we don't look at it as an intrinsic part of every LAN," explains Bert Ott, vice president of sales at Gateway Communications of Irvine, Calif. "The typical LAN consists of about nine workstations, so it has no great need for network management."

Meanwhile, in the token-ring world, vendors are not simply resigning themselves to defeat in the face of the 10Base-T juggernaut. Token ring, after all, is the IBM network of choice, and consequently is assured of a healthy future regardless of Ethernet's new-found vigor.

Token-ring networks run on the same physical star topology as 10Base-T, although IBM has yet to support an unshielded twisted-pair implementation of the 16-Mbps version. To date, only Proteon Inc. of Westborough, Mass., offers products of this type, says analyst Modahl.

Token ring is perceived as more expensive than Ethernet because of adapter costs that today average about $760, but the IBM standard may actually be less expensive than Ethernet networks when entire system costs are considered.

In any case, token ring has the advantages of providing IBM interoperability, offering a higher throughput rate (at 16 Mbps) than Ethernet and providing more built-in network management functions than its competitor, according to Nate Kalowski, Proteon's vice president of marketing. Still, he admits, "10Base-T will cut the cost of Ethernet substantially, and it has definitely improved Ethernet's long-term prospects." □

Heavyweights descend on the fault-tolerant Unix market

With such vendors as Tandem, Stratus and Hewlett-Packard getting into the act, the number of Unix-based computers sold for fault-tolerant applications is rising rapidly

BY RICK WHITING

Once the domain of a handful of small companies, the market for Unix-based, fault-tolerant computers is now attracting such industry heavyweights as Stratus Computer Inc., Tandem Computers Inc., Hewlett-Packard Co. and AT&T.

Last year the total value of fault-tolerant Unix computers shipped by such specialty vendors as Sequoia Systems Inc. and Integrated Micro Products Inc. barely reached $50 million, a tiny fraction of what Gartner Group Inc. analyst George Weiss estimates was a $2.5 billion worldwide market for fault-tolerant computers in 1989. But that situation is changing rapidly as Unix gains prominence as an industry standard.

"With the growth and expansion of the Unix market, it became apparent to us that Unix would become a driving force within the computer industry," says Shirley Henry, Tandem's Unix systems product marketing director. Cupertino, Calif.-based Tandem unveiled its first Unix-based system in January.

Weiss expects more vendors to begin marketing systems that combine Unix and fault-tolerant technology. "I think they are becoming more and more a part of the computing landscape," he says of the combination.

OLTP largely proprietary

With more customers buying computers to run such critical on-line transaction processing (OLTP) systems as automated bank teller machines, telephone switching equipment, lotteries and airline reservation systems, the market for fault-tolerant computers has been growing rapidly. Fault-tolerant systems are designed to keep running even if a component of the system fails.

International Data Corp. of Framingham, Mass., estimates that the worldwide fault-tolerant computer market more than doubled from $503 million in 1984 to $1.23 billion in 1988. Weiss estimates that sales of fault-tolerant systems will reach $6.2 billion in 1994.

But virtually all of those computers, sold by vendors like Stratus, Tandem and NCR Corp., have been based on proprietary operating systems. Because industry acceptance of Unix was uncertain and the operating system was notoriously difficult to adapt for fault-tolerant applications, sales of Unix computers for OLTP applications have been negligible.

In the mid-1980s, a number of companies were started with plans to field Unix-based, fault-tolerant computers. Few survived. Tolerant Systems Inc. stopped marketing its Eternity computer line in March, 1989 and continues today as a software-only company. BiiN, the joint venture of Intel Corp. and Siemens AG, was scuttled last year. Other companies, notably Auragen and Synapse, never really got off the ground.

Analysts say many of those pioneering companies failed because Unix was still in its infancy and because the vendors were too focused on hardware rather than offering complete hardware-software solutions.

The only survivors have been Sequoia of Marlborough, Mass., which originally focused on selling Pick-

Dave Bradley

William Elliott, Stratus vice president of strategic planning: The telecommunications market "has expressed a very clear interest in Unix systems"

based solutions, and Parallel Computers Inc. of Santa Cruz, Calif., which was acquired in 1988 by Integrated Micro Products Ltd. of Britain and renamed Integrated Micro Products Inc. Sequoia recorded 1989 sales of $31 million, while privately held IMP projects that its 1990 fiscal year sales will reach $15 million.

Share and share alike

But those vendors no longer have the market to themselves. Tandem and Stratus unveiled Unix-based systems within a few weeks of each other in January. At the same time Hewlett-Packard announced plans to enter the market by way of an OEM agreement with Sequoia, while AT&T did the same last month through a strategic alliance with Tandem. And IBM, which already resells Stratus' proprietary computers, may follow suit with Stratus' new Unix systems.

"Now we're not just talking about the lunatic fringe, we're talking about the mainstream computer companies that have come around," says Gartner Group's Weiss.

Along with industry acceptance of Unix, demand for fault-tolerant Unix computers within the telecommunications industry is providing much of the impetus for large vendors to enter the market, according to J. Neil Weintraut, an analyst with the Hambrecht & Quist Inc. investment firm.

Given that some 20% of Stratus' proprietary computers are already sold to U.S. and foreign telecommunications customers, William B. Elliott, Stratus vice president of strategic planning, expects a large number of the new Unix-based systems to follow that pattern. "That is a market that has expressed a very clear interest in Unix systems," he says.

Both vendors and industry watchers say that because Unix is already well established within the telecommunications and federal government markets those segments will account for the greatest share of Unix-based, fault-tolerant computer sales for the immediate future. But Tandem's Henry says the manufacturing sector is showing "surprising strength" in demand for such computers, and Weintraut believes retail applications also show promise.

Sequoia has had some success marketing its systems to such commercial customers as health maintenance organizations for record keeping and claims processing and distributors for inventory tracking and order processing, says Keith Johnson, marketing vice president. IMP has sold a number of Unix-based, fault-tolerant systems for hotel management and reservation applications, according to marketing vice president Brian Knowles.

Shirley Henry, Tandem's Unix systems product marketing director: "It became apparent to us that Unix would become a driving force within the industry"

And those markets are sure to grow as more Unix software for commercial and business applications hits the market. A prime example is Tuxedo, a Unix-based transaction processing system developed by AT&T and licensed by Pyramid Technology Corp., Sequent Computer Systems Inc. and others.

Customer of the future

QV Trading Systems Inc., a New York City supplier of financial information to stock traders and brokerage houses, may represent the customer of the future. Once locked into a proprietary computer from Unisys Corp., QV Trading switched to Unix so the company could shop around for the most cost-effective system to meet its needs and be compatible with workstations used by its customers, according to president Charles Weeden. QV Trading currently uses a Sequoia system.

Customers like QV Trading will remain the exception for some time, however. Analyst Weintraut says that while the growth rate for fault-tolerant Unix computer sales will be rapid, it will remain a small part of the overall fault-tolerant market for some time. Stratus' Elliott agrees, predicting that less than 10% of the systems his company will sell this year will go out the door with Unix.

While chasing the same markets, vendors are pursuing different product strategies. Tandem's Unix-based Integrity S2 is separate from its existing NonStop line of computers that run on the proprietary Guardian operating system. The Integrity S2 uses the R2000 RISC microprocessor from Mips Computer Systems Inc., making it the only fault-tolerant, Unix-based computer currently based on a reduced instruction set computer chip. Henry says the Mips microprocessor gives Tandem a price/performance advantage over Stratus, Sequoia and other manufacturers that base their systems on complex instruction set computer chips.

But that advantage will not last forever. Stratus of Marlborough, Mass., is developing a new line of systems based on Intel's i860 RISC chip, while Sequoia, as part of its OEM and technology-sharing alliance with Hewlett-Packard, will use HP's Precision Architecture RISC microprocessor in future designs.

Competitors argue that while the Tandem system is offered in different configurations with price tags of $170,000 to $250,000, it is largely a "point product," or single system rather than a line of computers. Henry responds that the company is developing a broad line of Unix-based computers and that using the Mips chip will speed up product development.

By contrast, Stratus has ported Unix to its existing XA2000 line of fault-tolerant systems and simply offers Unix, which it calls FTX, or the proprietary VOS operating system as options. Along with the advantage of being able to offer Unix across a broad product line, Elliott argues that Stratus does not have to predict demand for separate product lines as Tandem does.

Sequoia and IMP pride themselves on offering only Unix-based, fault-tolerant computers. "I have a singular focus on what I am doing," says Sequoia's Johnson.

Sequoia is focusing on the high end of the market with its large-scale Series 300 computer systems that start

The major players in fault-tolerant Unix

Company	Strategic partners	Projected Unix sales
Tandem Computers	AT&T, Nixdorf	$25 million in 1990, $50 million-plus in 1991*
Stratus Computer	IBM?	10% of 1990 revenue **
Sequoia Systems	Ultimate, Hewlett-Packard	$50 million in 1990*
IMP	Pyramid	$15 million in fiscal 1990**

* Analyst estimates ** Company estimates

it $300,000. Sequoia's computers are also able to run software applications written for the Pick operating system.

IMP's computers, on the other hand, sell in the range of $40,000 to $200,000 and are often sold for departmental applications and for use within distributed networks. The company recently announced a joint-marketing relationship with Pyramid under which IMP systems are sold for use as front-end systems for Pyramid's database servers.

Unix System V

Tandem, Stratus, IMP and Sequoia have all adapted Unix System V for fault-tolerant and transaction processing applications. Tandem, for example, has added error prevention and correction features to the operating system while Sequoia's Topix operating system uses a proprietary "kernel," or core instruction set with a Unix interface.

"Fault-tolerance really requires a ground-up design," says IMP's Knowles. However, all four companies have been careful to ensure that their operating systems remain compliant with the Unix System V Interface Definition.

As with their proprietary systems, Tandem and Stratus will likely sell most of their Unix-based computers directly to end-users, although a growing percentage of sales will go through alternate VAR and OEM channels. Stratus' Elliott points out that it is easier for resellers to port existing Unix applications to Stratus' FTX than to its proprietary VOS.

Through its alliance with Tandem, AT&T will market the Integrity S2 for network management applications, largely in the telecommunications and government markets, and the two companies will open "enterprise centers" to design computer networks for customers. Tandem has also signed an OEM pact with Nixdorf AG, now a part of Siemens.

A major question surrounding Stratus' Unix offering is whether IBM, which resells the XA2000 line under its own label, will offer the Unix option as well. (Elliott is "confident" IBM will do so, even though FTX would not be compatible with IBM's own AIX version of Unix.)

Sequoia's Johnson acknowledges that his company's size can be a handicap when competing against Tandem and Stratus. But he expects the recent alliances with HP and The Ultimate Corp. to remedy that. HP will sell Sequoia computers into the telecommunications market while Ultimate, which used to have a reseller pact with Tandem, will resell Sequoia computers into the Pick market.

The fault-tolerant computer market more than doubled from $503 million in 1984 to $1.23 billion in 1988

"If I were buying a $500,000 computer, I would feel more comfortable dealing with IBM," Johnson admits. "By having established companies agreeing to take my product into certain markets, I now have some breathing space." HP also made a $5.8 million equity investment in Sequoia, while Ultimate invested $4 million in the company. Johnson says those investments help boost the smaller company's credibility and allow Sequoia to take a more long-term view in its planning.

Johnson also argues that Sequoia and IMP have an advantage over Stratus and Tandem because the smaller companies are not newcomers to the Unix market. "They are years away from having a big part of their business being based on Unix," he says of the larger vendors.

But Tandem's Henry maintains it is the larger companies that have the advantage because of their experience in the fault-tolerant OLTP market. "The best way to be competitive in the Unix environment is to do something you already know a lot about," she argues.

With Tandem and Stratus now entering the market with fault-tolerant Unix systems, other big computer vendors will be forced to respond. And rather than develop their own systems, those vendors may form OEM alliances with existing manufacturers in order to get to market quickly.

Knowles predicts that the near future will see more vertical alliances between small, technology-driven companies like IMP and large vendors with more marketing savvy. "We see our strengths as technology and innovation," he says. Pointing to the HP-Sequoia pact as the wave of the future, Knowles believes that companies like IMP, which sells 50% of its systems through OEM partnerships and 30% through systems integrators, will benefit from such a trend.

Some large companies, however, may yet go it alone. In February Digital Equipment Corp. unveiled the VAXft 3000, a fault-tolerant version of its MicroVAX system running the proprietary VMS operating system. DEC gave no indication when or if it would port its Ultrix version of Unix to that computer, although International Data Corp. analyst David Card believes a more likely scenario is that sometime in the future DEC will debut a fault-tolerant version of its DECstation server that is based on RISC chips from Mips and runs Ultrix.

But despite the competition on the horizon, IMP's Knowles is optimistic the market for fault-tolerant Unix computers will be big enough for even small companies like his to prosper. "The growth is going to be extremely high," he says. "I think history is showing that our timing was pretty good." □

Computers see a glimmer of hope

In the final three months of 1989, new orders for computers and office equipment expanded 5.5% from the year-ago quarter, while shipments edged up almost 3%. Preliminary numbers show orders increased 1.3% from December to January, 1990, and 5.2% from January 1989; shipments edged up 0.6% and 8.5% over the same time periods.

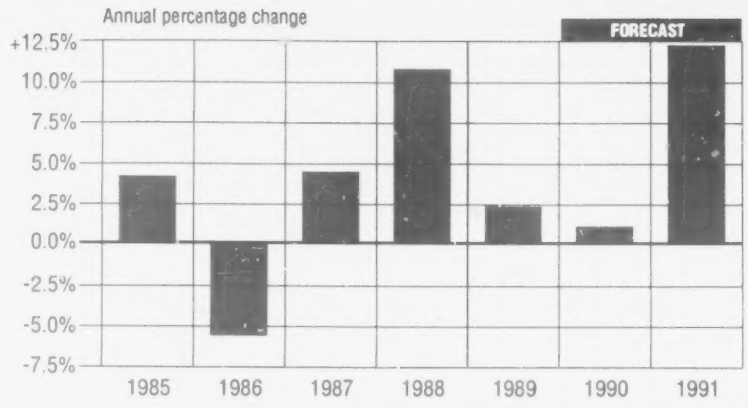
But don't expect a full-fledged recovery just yet. Over a year ago, the ELECTRONIC BUSINESS Leading Indicator popped up slightly before heading down to its trough in September 1989. Cahners Economics expects a similar growth pattern in orders and shipments for the computer industry.

Right now, the computer and office equipment sector appears to be plagued by some over-capacity and over-production. The low level of backlogs attest to this situation. Although up slightly from the end of the third quarter, unfilled orders at year-end 1989 fell 6% below the prior year. In January, backlogs slipped further to $12.5 billion. As manufacturers bring production in line with demand, expect to see more layoffs, cutbacks and restructurings.

Although computer makers will need to do a lot of streamlining to stay afloat this year, 1991 looks more promising as the economy picks up steam once again.

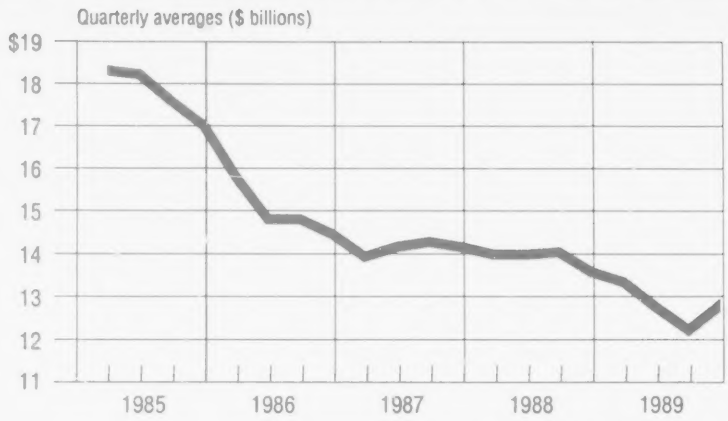
MADELINE FRANCHI, Cahners Economics

Growth in computer shipments wane this year...



Data source: U.S. Commerce Department; Forecast: Cahners Economics

...and backlogs shrink to low levels



Data source: U.S. Commerce Department; Forecast: Cahners Economics

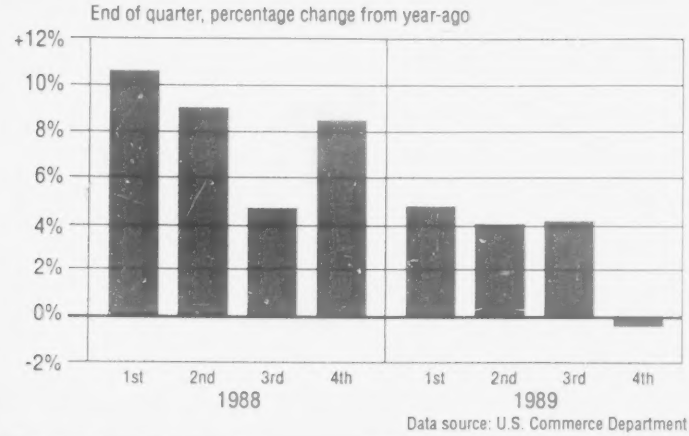
Computer market database

Latest quarter: 4th quarter 1989	Latest quarter	Previous quarter	Change	Year ago	Change	Next year	Change
Industrial production (SA,1977=100, qtr. average)	350.60	351.40	-0.23%	322.00	+8.88%	357.98	+2.10%
Shipments (SA, $ millions, qtr. total)	$17,325	$17,688	-2.05%	$16,839	+2.89%	$18,277	+5.50%
New orders (SA, $ millions, qtr. total)	$17,506	$17,959	-2.52%	$16,590	+5.52%	$17,844	+1.93%
Unfilled orders (SA, $ millions, end of qtr.)	$12,658	$12,477	+1.45%	$13,471	-6.04%	$11,267	-10.99%
Inventory-to-shipment ratio (SA, end of qtr.)	2.11	2.07	—	2.13	—	1.96	—
All employees (thousands, end of qtr.)	475.90	474.60	+0.27%	479.40	-0.73%	470.20	-1.20%
Production workers (thousands, end of qtr.)	159.40	157.00	+1.53%	156.30	+1.98%	154.98	-2.77%
Business purchases (SAAR, current $ billions)	$46.10	$46.80	-1.50%	$42.77	+7.79%	$45.76	-0.74%
Business purchases (SAAR, 1982 $ billions)	$131.38	$128.92	+1.91%	$110.86	+18.51%	$138.44	+5.37%

SA = seasonally adjusted; SAAR = seasonally adjusted annualized rate; all other data is not seasonally adjusted

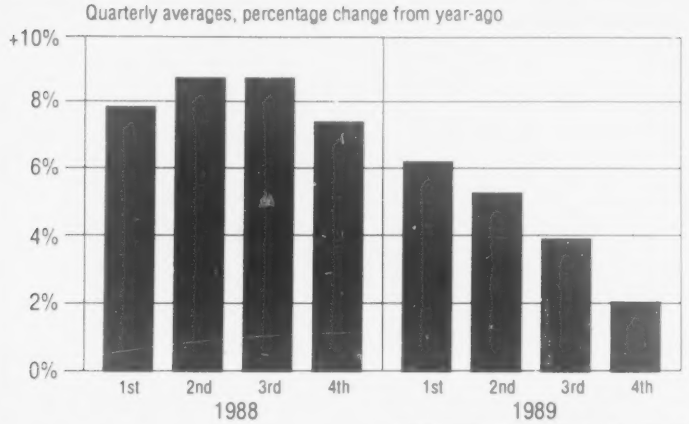
Data sources: Federal Reserve Board, U.S. Bureau of the Census and U.S. Bureau of Labor Statistics
All data for SIC 357, except industrial production, SIC 357-9. Forecasts: Cahners Economics

Backlog growth in instruments dwindles...



Data source: U.S. Commerce Department

...and so does employment of production workers...



Data source: U.S. Commerce Department

...but inventory kept in check

Data source: U.S. Commerce Department

Instruments industry down but not out

U.S. manufacturers of instruments and controls continued to increase output at the end of last year, but the rate of growth slowed to a trickle. In 1989's fourth quarter, production rose just 1.2% compared with the year-earlier period and actually fell 1.6% from the third quarter. The industry has already cut into its backlogs to keep factories humming along. Unfilled orders amounted to $13.5 billion in January —0.6% below the year-ago value. This marks the second month in a row of year-to-year declines — which has not happened since the 1975 recession when unfilled orders fell for six straight months.

The weakness is depressing employment growth, too. In the third quarter of 1988, growth in employment of production workers in the instruments industry swelled 9% from the same period the prior year. By the final quarter of last year, employment edged up just 2%. Production growth will continue to contract through most of this year, forcing further shrinkage in employment gains into mid-1991.

Yet the situation could be more damaging if not for the fact that inventory has been held in check. In January 1990, inventory was valued at $10.4 billion — 0.6% lower than a year earlier. The inventory-to-shipments ratio (months of supply on hand) fell from its most recent high of 2.6 in March 1989 to 2.29 in January. This represents the second lowest monthly ratio ever recorded — a clear indication that production cutbacks will not be jarring. Cahners Economics forecasts output to expand 3.2% for all of 1990 compared to 5.6% annual growth in 1989.

However, some sectors will take the brunt of the cyclical slowdown. Instruments with a high unit price or sold to a narrow customer base tend to be more cyclically sensitive.

The ELECTRONIC BUSINESS automatic test equipment sales index collapsed 15% in the fourth quarter of 1989 compared with a year earlier. On an annual basis, the index dropped 7.5%. Slower growth in semiconductor sales and a shift to lower-priced test equipment are wreaking havoc with the classical ATE sector. The industry will see a continued withering away of sales in 1990 by about 4.5%.

MADELINE FRANCHI, Cahners Economics